SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS

Idaho Operations Office – Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho LLC

Underwater Gamma Spectroscopy

An underwater gamma spectrometer was used to measure three unidentified objects that were recovered from the CPP603 fuel storage basins during fuel removal. These items were significantly radioactive and did not resemble known fuel elements. Because the fuel storage basins are being prepared for sludge removal as a part of decommissioning, it was necessary to determine whether these objects were to be managed as fuel or discarded as radioactive waste. Gamma ray spectrometry was used to distinguish isotopic content. From the isotopic characteristics, it was determined that the uranium content of one of the three objects was a fuel component and would be managed accordingly, while the remaining objects could be discarded.

Benefit: The fuel determination made by this device prevented nuclear fuel material from being disposed of as low level waste.

Qualitative Benefit Analysis		
Programmatic Risk	●	Completion of decommissioning of the fuel storage basins eliminates environmental risks. This tool provides information for appropriate management.
Technical Adequacy	●	Gamma spectrometry is more effective in determining unknowns than other common nondestructive analyses because prior knowledge of object characteristics is not required.
Safety	●	Being able to perform characterization in the basin eliminates moving the objects to another location without knowing the risk that they represent.
Schedule Impact	●	Availability of this technology allowed the project to progress.

●	◒	○	◓	◉
Major improvement	Some improvement	No change	Somewhat worse	Major Decline

Quantitative Benefit Analysis	
Cost Impact Analysis	This is enabling technology that allowed resolution of material management concerns. It does not replace a prior alternative, and as such does not represent a comparative cost savings.

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Addendum to Underwater Gamma Spectroscopy

This technology deployment helped address needs ID-7.2.37: Fuel Pool Disposition Technologies, ID-7.2.20: Underwater Radionuclide Characterization of Structures, Equipment, and Containment Pool Walls that Produces Quantitative Data. and ID-7.2.06: Remote Characterization for Building Release, Large Area Surface Soil Characterization, and Characterization of Sumps, Debris, Underwater Areas, and Buried Pipes and Utilities.

ESTIMATE BASIS FOR: **Underwater Gamma Spectroscopy**

Worksheet 2: Itemized Project Funding Requirements*
(i.e., One Time Implementation Costs)

Category		Cost $
INITIAL CAPITAL INVESTMENT		
1. Design		$ 178,040
2. Purchase		$ 39,900
3. Installation		$ 28,870
4. Other Capital Investment (explain)	Fabrication costs	$ 51,485
	Subtotal: Capital Investment= (C)	$ 298,295
INSTALLATION OPERATING EXPENSES		
1. Planning/Procedure Development		$ 5,000
2. Training		$ 2,500
3. Miscellaneous Supplies		$ 300
4. Startup/testing		$ 3,500
5. Readiness Reviews/Management Assessment/Administrative Costs		$ 2,500
6. Other Installation Operating Expenses (explain)		$ -
	Subtotal: Installation Operating Expense = (E)	$ 13,800
7. All company adders (G & A/PHMC Fee, MPR, GFS, Overhead, taxes, etc.)(if not contained in above items)		$ -
	Total Project Funding Requirements=(C + E)	$ 312,095
Useful Project Life = (L) 5 Years	Time to Implem 18 Months	
Estimated Project Termination/Disassembly Cost (if applicable) = (D) (Only for Projects where L<5 years; D=0 if L>5 years)		$ -

TOTAL LIFE-CYCLE COST SAVINGS CALCULATION FOR IPABS-IS

(Before - After) x (Useful Life) - (Total Project Funding Requirements + Termination)

Total Life Cycle Cost Savings Estimate = (B - A) x L - (C+E+D)

RETURN ON INVESTMENT CALCULATION

Return on Investment (ROI) % =

$$\frac{\textit{(Before - After) - [(Total Project Funding Requirements + Termination)/Useful Life]}}{\textit{[Total Project Funding Requirements + Project Termination]}} \times 100$$

$$\text{ROI} = \frac{\text{(B-A)-[(C+E+D)/L}}{\text{(C+E+D)}} \times 100 \quad -20 \ \%$$

O&M Annual Recurring Costs:				Project Funding Requirements:			
Annual Costs, Before=	$	-	(B)	Capital Investment=	$	298,295	(C)
Annual Costs, After=	$	-	(A)	Installation Op. Exp=	$	13,800	(E)
Net Annual Savings=	$	-	(B-A)	Total Project Funds=	$	312,095	(C+E)

Note: Before (B) and After (A) are Operating & Maintenance Annual Recurring Costs from Worksheet 1.

* See attached Supporting Data and Calculations.

ESTIMATE BASIS FOR: **Underwater Gamma Spectroscopy**

GENERAL

The INEEL Spent Nuclear Fuel program used an underwater gamma spectrometer developed at INEEL to measure three unidentified objects that were recovered from the CPP603 fuel storage basins during fuel removal. The spectrometer uses a cadmium zinc telluride detector that does not require liquid nitrogen cooling. Its design includes remotely operated collimation to allow measurement of objects having highly varied radiation fields, as well as the option of remotely changing the object-to-detector distance. A special fixture integral to the spectrometer aligns the objects in the collimated field of view. Gamma ray spectrometry was used to distinguish isotopic content. From the isotopic characteristics, it was determined that the uranium content of one of the three objects was a fuel component and would be managed accordingly, while the remaining objects could be discarded.

INITIAL CAPITAL INVESTMENT

INEEL's initial capital investment included design, component purchase, and fabrication cost, which amounted to $298,295.00

INSTALLATION AND START-UP

Installation and startup costs amounted to $13,800 and included procedure development, training and calibration.

TRADITIONAL (BASELINE) TECHNOLOGY/METHOD

No traditional baseline technology was identified for this issue. The alternative of transporting these items to another facility for destructive analysis was considered unacceptable.

ESTIMATE BASIS FOR: **Underwater Gamma Spectroscopy**

NEW TECHNOLOGY/METHOD

The spectrometer uses a cadmium zinc telluride detector that does not require liquid nitrogen cooling. Its design includes remotely operated collimation to allow measurement of objects having highly varied radiation fields, as well as the option of remotely changing the object-to-detector distance. A special fixture integral to the spectrometer aligns the objects in the collimated field of view. Gamma ray spectrometry was used to distinguish isotopic content. From the isotopic characteristics, it was determined that the uranium content of one of the three objects was a fuel component and would be managed accordingly, while the remaining objects could be discarded. Gamma spectrometry is more effective in determining unknowns than other common nondestructive analyses because prior knowledge of object characteristics is not required. In this instance, the measurement was able to confirm the presence of fission products as well as uranium and through analysis, a conservative quantitative estimate was made.

COST SAVINGS/COST AVOIDANCE/RISK REDUCTION

The cost of development of safety analyses for transportation of these objects to a laboratory for destructive analysis, added to the cost of disposal of associated wastes is estimated at $475K with an estimated $250K of costs at the other facility such as at ANL-W. Detailed estimated is provided below. The costs identified for alternative measurement methods are as follows assuming that the suspected material would be transported to ANL-W for examination at HFEF:

Movement of the material canister into HFEF-6 cask	$ 15K
Operational Readiness Review	$ 200K
Safety Analysis Review	$ 100K
Transport Planning Package	$ 10K
Loading of material into cask	$ 15K
Out of Commerce shipment using HFEF-6 cask	$ 15K
Procedure development	$ 50K
Training	$ 15K
Planning Controls Engineer	$10K
Project Management	$ 10K
Preventative Maintenance of Equipment	$ 5K
Miscellaneous Budget, Planning and Reporting	$ 30K
Receipt of shipment, gas analysis, sectioning, dissolution and radiochemistry by ANL-W	$ 250K
Total Cost	$ 725K

SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS DEPLOYMENT APPROVALS

Technology Deployed: Underwater Gamma Spectroscopy

Date Deployed: May 2, 2001

EM Program(s) Impacted: Spent Nuclear Fuel Program

Approval Signatures

Larry J. Ferrell 8/9/01

Contractor Program Manager Date

N/A

Contractor Program Manager Date

Peter J. Dirkmaat Sept 14, 2001

DOE-ID Program Manager Date

N/A

DOE-ID Program Manager Date